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Dry Modifications of PCL/Chitosan/PCL Tissue Scaffolds

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Abstract : Natural polymers are widely used in tissue engineering applications, because of their biocompatibility, biodegradability and solubility in the physiological medium. On the other hand, synthetic polymers are also widely utilized in tissue engineering applications, because they carry no risk of infectious diseases and do not cause immune system reaction. However, the disadvantages of both polymer types block their individual usages as tissue scaffolds efficiently. Therefore, the idea of usage of natural and synthetic polymers together as a single 3D hybrid scaffold which has the advantages of both and the disadvantages of none has been entered to the literature. On the other hand, even though these hybrid structures support the cell adhesion and/or proliferation, various surface modification techniques applied to the surfaces of them to create topographical changes on the surfaces and to obtain reactive functional groups required for the immobilization of biomolecules, especially on the surfaces of synthetic polymers in order to improve cell adhesion and proliferation. In a study presented here, to improve the surface functionality and topography of the layer by layer electrospun 3D poly-epsilo--caprolactone/chitosan/poly-epsilon-caprolactone hybrid tissue scaffolds by using atmospheric pressure plasma method, thus to improve cell adhesion and proliferation of these tissue scaffolds were aimed. The formation/creation of the functional hydroxyl and amine groups and topographical changes on the surfaces of scaffolds were realized by using two different atmospheric pressure plasma systems (nozzle type and dielectric barrier discharge (DBD) type) carried out under different gas medium (air, Ar+O2, Ar+N2). The plasma modification time and distance for the nozzle type plasma system as well as the plasma modification time and the gas flow rate for DBD type plasma system were optimized with monitoring the changes in surface hydrophilicity by using contact angle measurements. The topographical and chemical characterizations of these modified biomaterials' surfaces were carried out with SEM and ESCA, respectively. The results showed that the atmospheric pressure plasma modifications carried out with both nozzle type plasma and DBD plasma caused topographical and functionality changes on the surfaces of the layer by layer electrospun tissue scaffolds. However, the shelf life studies indicated that the hydrophilicity introduced to the surfaces was mainly because of the functionality changes. Therefore, according to the optimized results, samples treated with nozzle type air plasma modification applied for 9 minutes from a distance of 17 cm and Ar+O2 DBD plasma modification applied for 1 minute under 70 cm3/min O2 flow rate were found to have the highest hydrophilicity compared to pristine samples.

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